

CLAIMS

1. A method of producing a Group III nitride semiconductor device having a chip shape which is a pentagonal or more highly polygonal shape, comprising a first step of epitaxially growing a Group III nitride semiconductor on a substrate to form a semiconductor wafer; a second step of irradiating said semiconductor wafer with a laser beam to form separation grooves; a third step of grinding and/or polishing the main surface side different from the epitaxially grown main surface of the substrate; and a fourth step of division into individual chips by applying stress to said separation grooves.

2. A method of producing a Group III nitride semiconductor device according to claim 1, wherein the first step, the second step, the third step and the fourth step are included in this order.

3. A method of producing a Group III nitride semiconductor device according to claim 1 or 2, further including a fifth step of forming trenches, in which at least the n-type layer is exposed, corresponding to the positions for forming the separation grooves.

4. A method of producing a Group III nitride semiconductor device according to claim 3, wherein the fifth step exists before the second step.

5. A method of producing a Group III nitride semiconductor device according to claim 3, wherein the fifth step exists after the second step.

6. A method of producing a Group III nitride semiconductor device according to any one of claims 1 to 5, wherein the second step irradiates a laser beam from the semiconductor side of the semiconductor wafer.

7. A method of producing a Group III nitride semiconductor device according to any one of claims 1 to 6, wherein the separation grooves at least partly reach the substrate.

8. A method of producing a Group III nitride

semiconductor device according to any one of claims 1 to 7, wherein the second step irradiates a laser beam from the substrate side of the semiconductor wafer.

5 9. A method of producing a Group III nitride semiconductor device according to claim 8, wherein the second step comprises a step of irradiating a laser beam from the semiconductor side of the semiconductor wafer and a step of irradiating a laser beam from the substrate side of the semiconductor wafer.

10 10. A method of producing a Group III nitride semiconductor device according to any one of claims 1 to 9, wherein the separation grooves have a V-shape in cross section.

15 11. A method of producing a Group III nitride semiconductor device according to any one of claims 1 to 10, wherein the second step forms a separation groove of the form of a polygonal line that is bent, forms a plurality of separation grooves, of the form of a polygonal line that is bent, in a form of being
20 translated in parallel and, then, forms linear separation grooves by connecting every other bending point of the neighboring separation grooves in the form of a polygonal line.

25 12. A method of producing a Group III nitride semiconductor device according to any one of claims 1 to 10, wherein the second step forms first separation grooves of the form of a broken line, forms second separation grooves of the form of a broken line that intersect the first separation grooves of the form of the
30 broken line at a first angle, and forms third separation grooves of the form of a broken line that intersect the second separation grooves of the form of the broken line at a second angle and further intersect the first separation grooves of the form of the broken line at a
35 third angle, the sum of the first angle, the second angle and the third angle being 180 degrees.

13. A method of producing a Group III nitride

semiconductor device according to any one of claims 1 to 12, wherein the semiconductor wafer is ground and/or polished at the third step to be not thicker than 150 μm .

14. A method of producing a Group III nitride semiconductor device according to any one of claims 1 to 13, wherein the fourth step is executed by pushing the substrate onto a spherical metal mold.

15. A method of producing a Group III nitride semiconductor device according to any one of claims 1 to 14, wherein the chip shape is substantially an orthohexagonal shape.

16. A method of producing a Group III nitride semiconductor device according to any one of claims 1 to 14, wherein the chip shape is substantially a pentagonal shape.

17. A method of producing a Group III nitride semiconductor device according to claim 16, wherein the second step forms separation grooves of a hexagonal shape by forming separation grooves of the form of a polygonal line that is bent, forming separation grooves of the form of a plurality of polygonal lines that are bent in a form of being translated in parallel and, then, forming linear separation grooves by connecting every other bending point of the neighboring separation grooves of the form of polygonal lines and, further, forms linear separation grooves connecting the opposing two sides of the separation grooves of said hexagonal form.

18. A method of producing a Group III nitride semiconductor device according to claim 16, wherein the second step forms separation grooves of the form of a hexagonal shape by forming first separation grooves of the form of a broken line, forming second separation grooves of the form of a broken line that intersect the first separation grooves of the form of the broken line at a first angle, and forming third separation grooves of the form of a broken line that intersect the second separation grooves of the form of the broken line at a

second angle and, further, intersect the first separation grooves of the form of the broken line at a third angle, the sum of the first angle, the second angle and the third angle being 180 degrees and, further, forms linear separation grooves connecting the opposing two sides of the separation grooves of said hexagonal form.

19. A method of producing a Group III nitride semiconductor device according to any one of claims 1 to 10, 13 and 14, wherein the chip is substantially of a circular form.

20. A method of producing a Group III nitride semiconductor device according to any one of claims 1 to 19, wherein the Group III nitride semiconductor device is a light-emitting device.

21. A method of producing a Group III nitride semiconductor device according to claim 20, wherein the first step forms the semiconductor wafer by epitaxially growing an n-type layer, a light-emitting layer and a p-type layer comprising the Group III nitride semiconductor in this order on the substrate.

22. A Group III nitride semiconductor light-emitting device produced by a production method of claim 20 or 21.

23. A lamp comprising a light-emitting device of claim 22.

24. A lamp according to claim 23, wherein a light energy conversion material is arranged more at the end portion than at the center of a semiconductor chip forming a light-emitting device.